900 132

INSTRUCTION AND MAINTENANCE MANUAL
FOR SERIES 313
AC POWER CONTROLLERS
WITH TIME PROPORTIONING CONTROL

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MP MASTER
MA32099

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1.0 INTRODUCTION

1.1 The Series 313 Triac/SCR Power Controllers provide solid-state zero voltage gating time proportioning control of single phase AC power. Single Traics are used for current ratings of 25 amperes and below; while back-to-back SCR's (thyristors) are used for higher current ratings. The Triac or SCR devices serve as a solid state "switch" which, when closed, (at the instant of zero line voltage) applies full line voltage to the load.

1.2 Time proportioning is obtained by closing the "switch" (denoted "ON") for a certain number of half-cycles, and opening the "switch" (denoted "OFF") for a second certain number of half-cycles of the AC supply. The ratio of the number of "ON" half-cycles to the total number of "ON" plus "OFF" half-cycles (denoted duty-cycle) is proportional to the average power delivered to a resistive load. The RMS value of the output voltage or current is approximately a linear function of the DC input control signal. Thus the duty cycle is proportional to the square of the DC input control signal.

2.0 POWER REQUIREMENTS

2.1 Refer to nameplate or Table I for line voltage rating. Nominal value of line is ±10%, single-phase. Standard ratings are: 120V, 208V, 240V, 277V, 347V, 380/415V, 480V and 600V, 50/60 Hz. For current ratings see pages 19 & 20 Tables 1 and 2.

3.0 LOAD RATINGS

3.1 RMS load voltage is controllable from zero to full line voltage (less 1.5VAC Triac/SCR forward drop). The RMS value of the voltage output is approximately linear (within ±3%) with average DC control over the range 20% to 95% output. The unit will maintain the RMS value of the output voltage within ±1% at any setting between 20% and 90% output voltage for a ±10% variation in supply voltage.

All units described in this manual are easily changed to fast time base operation by removing a simple mechanical jumper on the component side of the control card. (See Fig. 2, Page 11.

3.2 Refer to nameplate or Table I for current rating. RMS load current rating is for continuous operation in free air at ambient temperatures of 50°C (122°F) or less. Typical momentary overload capability is 300% of RMS nameplate rating for 16¢ milliseconds. All units will operate up to 65°C ambient provided the rated nameplate current is reduced 1.43% per °C above 50°C.

3.3 These units must be operated into resistive loads drawing less than the rated nameplate current (3 ampere minimum). The KVA ratings listed for these panels are approximate only and should not be used to calculate the current rating. The load resistance should be such that under conditions of maximum line voltage, the nameplate current rating is not exceeded.

3.4 The following type loads connot be used with these panels:

Transformer coupled loads, globars or molybdenum loads which require inrush current limiting, incandescent lamps or other fast response loads.

3.5 All 313 series controllers from 40 Amperes and above can control up to seven (7) individual slave controllers. Units 25 amperes and below cannot control slave units and no slave units 25 amp and below are available. For slave part number add -20 to the master part number; i.e., for 313 125-40 a similar slave unit is 313 145-00.

4.0 METERING

4.1 Damping or averaging is required in metering circuits to prevent conventional ammeters and voltmeters from following the ON-OFF action of the 313 Series. To provide RMS sensing with the required damping, Robicon offers high accuracy Auxiliary voltage and current converters for use only when metering is required. Refer to factory for additional information on part numbers 359 015 and 359 016.

4.2 If an approximate (±15%) indication of output voltage is desired for checking operation of a panel, the circuit given on page 15 will provide this information.

5.0 INSTALLATION AND OPERATION

5.1 Installation Precautions:

These air cooled panels are rated for operation in ambients of 50°C (122°F) maximum. They should be mounted vertically in open air spaces. If the panels are mounted in spaces with restricted air flow, precautions should be taken to insure a steady-state ambient of less than 50°C. (See paragraph 3.2 page 3.)

5.2 Power Connections:

Connect one side of the load to T1. Connect one side of the line to L1. Connect the other side of the line to the remaining side of the load and run a separate lead from this junction to screw terminal L2. This is for control purposes only. Make sure all connections are tight.

5.3 Control Connections:

5.31 Manual Control - remote potentiometer. See Figure 4, page 13. Connect the remote potentiometer as follows: Connect the clockwise end of the pot to terminal 4, the wiper to terminal 5, and the counterclockwise end to terminal 6. Clockwise rotation will increase output. The resistance of the pot can be anywhere between 135 ohms and 3K ohms.

5.32 Manual Control - P1 GAIN potentiometer. See Figure 5, page 13. Connect terminals 4 and 5 together. Clockwise rotation of P1 GAIN potentiometer will increase output. Full output will be obtained at approximately 1/3 CW rotation.

5.33 Voltage Control - See Figure 6, page 13. Connect the positive end of a variable voltage source to terminal 5 and the negative end to terminal 6. The unit will accommodate sources from 0-3 through 0-45VDC. The input resistance varies between 3K and 5K (depending upon the setting of P1 GAIN pot).

5.34 Current Control - See Figure 7, page 14, and Table I. Connect the positive end of a variable current source to terminal 5 and the negative end to terminal 6. A resistor is required to change the current signal into a voltage that will control the unit. See Figure 7, page 14.

5.4 Operational Adjustments - Bias and Gain:

It will be necessary to monitor the output of the unit for the following adjustments. The output may be monitored with an appropriate AC voltmeter. CAUTION: DO NOT SHORT ANY TERMINALS TOGETHER. DO NOT CONNECT ANY GROUNDED INSTRUMENTS TO THESE TERMINALS. If Robicon voltage or current metering converters have been ordered with the panel, these may be used also.

5.41 Bias Adjustment:

The "Bias" pot is used for setting the "OFF" point. See Fig. 2, page 11. A simple aid for setting the bias pot is to remove the jumper from the left side of the test point (Fig. 1) and place this jumper on the center two pins. This will make the bias pot switch the output in a bistable manner. With zero input signal adjust the bias clockwise until the output snaps on, then counter-clockwise until the output snaps off. Remove the jumper from the center two pins and do not re-install jumper at this time.

5.42 Gain Adjustment: (For "0" based control signal.)

Now set the input control for the maximum control required. Turn the "Gain" pot clockwise a little at a time until the output starts to operate in a pulsing fashion. Keep turning the "Gain" pot clockwise (allowing time for the electronics to settle) until the output just remains "full on". This may require minor adjustments for a minute or two.

The above procedure is used for 0-5 mADC, 0-3VDC, 0-16VDC control signals. For control signals of 6-9V, 2-12 mADC, 4-20 mADC, 10-50 mADC, a slightly different adjustment is required.

Special Note: For 6-9V control adjust the bias and gain as above, for 0-3VDC, then apply 6VDC to the input terminals, move jumper to the center two pins and adjust the bias pot CCW until the output snaps off. Put the jumper on the right two pins for "Power Linear With Command", left two pins for "RMS Voltage Linear With Command".

For 2-12 mADC control adjust the bias as in 5.41 above and adjust the Gain pot for 10 mADC. Then set 2 mADC input, change jumper to the two center pins. Adjust bias so that the output just snaps off. Remove and place jumper in desired location for "RMS" or "Power Linear".

For 4-20 mA adjust as above for 0 to 16 mA and then set in 4 mADC and adjust bias to be just off as above.

Same as for 10-50 mADC, but use 0-40 mA, then go to 10 mA and adjust the bias.

Alternate Control Set-up Method for Old Style Controller and Special Use Devices

5.43 BIAS Adjustment - The bias pot is used for setting the off point. Apply power to the unit. Remove the control signal from the unit or turn the manual pot full CCW. Turn the bias pot CW a little at a time until the output starts to operate in a pulsing fashion. Turn the bias pot CCW a little at a time until the output just remains full off. This may require minor adjustments for a minute or two until the electronics settle internally.

5.44 GAIN Adjustment - Now set the input control for the maximum control required. Turn the gain pot CW a little at a time until the output starts to operate in a pulsing fashion. Keep turning the gain pot CW (allowing time for the electronics to settle) until the output just remains full on. This may require minor adjustments for a minute or two.

The above procedure is used for 0-5 mADC, 0-3VDC, 0-16VDC control signals. For control signals of 6-9V, 2-12 mADC, 4-20 mADC, 10-50 mADC, a slightly different adjustment is required.

Special Note: For 6-9V control, adjust the bias and gain as above for 0-3VDC. Then apply 9VDC to the input terminals and turn the bias CCW a little at a time until the output starts to turn off in a pulsing fashion. Then turn the bias pot slightly CW until the output just stays full on. It may be necessary to make minor adjustments for a minute or two until the electronics settle. The unit is now recalibrated for 6-9V control.

For 2-12 mA DC control, adjust the bias as in 7.41 above and adjust the gain pot for 0-10 mA DC at the input terminals. hen set 12 mA DC input and turn the bias CCW a little at a time until the output starts to operate in a pulsing fashion. Turn the bias CW a little at a time until the output does not pulse but stays full on for a minute or two. The unit is now recalibrated for 2-12 mA DC control.

For 4-20 mA DC control, adjust the bias as in 7.41 above but adjust the gain pot for 0-16 mA control input and adjust input for 20mA DC. Turn the bias CCW until the output starts to operate in a pulsing fashion, then slowly CW until the output just stays full on for a minute or two. The unit is now recalibrated for 4-20 mA DC control.

The procedure is exactly the same for 10-50 mA DC control. Adjust the gain pot for 0-40 mA and adjust the bias for 50 mA.

For 4-20 mA adjust as above for 0 to 16 mA and then set in 4 mADC and adjust bias to be just off as above.

Same for 10-50 mADC, but use 0-40 mA, then go to 10 mA and adjust the bias.

6.0 MAINTENANCE

6.1 Periodic Inspection:

6.11 It is important that the unit be kept clean. A layer of dust or process waste will reduce the heat transferring properties of the heat sinks. It is recommended that the dust be blown off periodically.

6.12 All units subjected to corrosive atmospheres should have the electrical connections periodically inspected. Tarnished connections should be cleaned and joint compound applied. Alcoa No. 2 Joint Compound is recommended for field applications. See the manufacturer's instructions on the can for joint preparation.

6.2 Component Replacement:

If any electrical components are unfastened during inspection or during troubleshooting, prepare the surfaces as follows: All fuse ends and connections should be cleaned according to the instructions with Alcoa No. 2 Joint Compound before the compound is applied. Triacs or SCR's should be treated with Wakefield #120 Thermal Joint Compound according to the manufacturer's instructions (sparingly).

7.0 TROUBLESHOOTING

The following checks can be made with a multimeter. Replacement of Triacs or SCR's can be made in the field, but if the trouble is ascribed to the control board, the unit must be returned to the factory. Refer to Section 7.5 before replacing any Triac or SCR.

CAUTION: THE VOLTAGES PRESENT ON THESE UNITS ARE DANGEROUS. MAKE SURE THE POWER IS OFF WHILE SERVICING.

7.1 Symptom: No output voltage or current.

Probable Cause: No input.

Remedy: Check for rated input voltage.

Probable Cause: Incorrect wiring of external circuit.

Remedy: Check for proper load and control connections. Check for connection from load to terminal L2.

7.2	Symptom:	No output voltage or current.
	Probable Cause:	Blown fuse.
	Remedy:	Open power to controller. Disconnect one end of fuse and check resistance with ohmmeter. It should measure less than 1 ohm. Replace, if necessary, with SAME TYPE. DO NOT INSTALL ANY OTHER TYPE OF FUSE. Measure load resistance and make sure that panel is not being used beyond its rated current. Check for high input voltage.
	Probable Cause:	Incorrect bias setting or input signal.
	Remedy:	Check settings as per section 5.4 and readjust, if necessary.
7.3	Symptom:	Output voltage present, but no output current.
	Probable Cause:	Load is open.
	Remedy:	Repair open element.
7.4	Symptom:	Full output.
	Probable Cause:	Bias, Gain or input signal too high.
	Remedy:	Check settings as per Section 5.4 and readjust if necessary. Refer to Figures 5-8 (pages 13 & 14. If turning Gain control to max. CCW position does not cause output to decrease, Bias is too high. With input signal disconnected, turning Bias control CCW should cause output to decrease.
7.5	Symptom:	Full output.
	Probable Cause:	Malfunctioning Triac or SCR.
	Remedy:	Disconnect the two leads of a suspected Triac or SCR. The heavy gauge lead is the cathode or A1, the lighter gauge lead is the gate and the case is the anode or A2. Check the resistance readings for conformity to the following table:

SCR's

Anode	Cathode	Gate	Ohmmeter Reading
Open	Neg.	Pos.	5 to 100 ohms
Open	Pos.	Neg.	40 ohms or greater
Pos.	Neg.	Open	1 Megohm or greater
Neg.	Pos.	Open	1 Megohm or greater
Pos.	Both negative		1 Megohm or greater
Neg.	Both Positive		1 Megohm or greater

TRIACS

A2 (Stud)	A1	G	Ohmmeter Reading
Open	Neg.	Pos.	5 to 100 ohms
Open	Pos.	Neg.	5 to 100 ohms
Pos.	Neg.	Open	1 Megohm or greater
Neg.	Pos.	Open	1 Megohm or greater
Pos.	Open	Neg.	1 Megohm or greater
Neg.	Open	Pos.	1 Megohm or greater

Because of manufacturing differences a Triac or SCR not conforming to this table may be good and a Triac or SCR conforming may be defective. In the latter case, the Triac or SCR could be breaking down (shorting) when exposed to rated voltage. The only way to test for this in the field is to substitute a Triac or SCR known to be good. If the symptoms are cleared, the replaced thyristor was defective.

7.6 Symptom: Output non-linear

Probable Cause: Improper operation of control circuitry on P.C. Board.

Remedy: Assuming the output of the unit can be controlled from full OFF to full ON, proceed as follows:

7.61 Monitor the panel output with either a Robicon converter (P/N 359 015) or (P/N 359 016) or build the circuit described on page 15 of this manual. This circuit provides indication only and is not intended to be accurate.

7.62 Monitor the control input using a voltmeter for voltage control, a milliammeter for current control or a calibrated potentiometer for manual control as required.

7.63 Set the Bias and Gain controls as previously described in Section 5.4.

7.64 Adjust control to 100% (full output). Converters should read 100% current or voltage as determined by load and input voltage. The test circuit should read within the outside limits shown on the graph on page

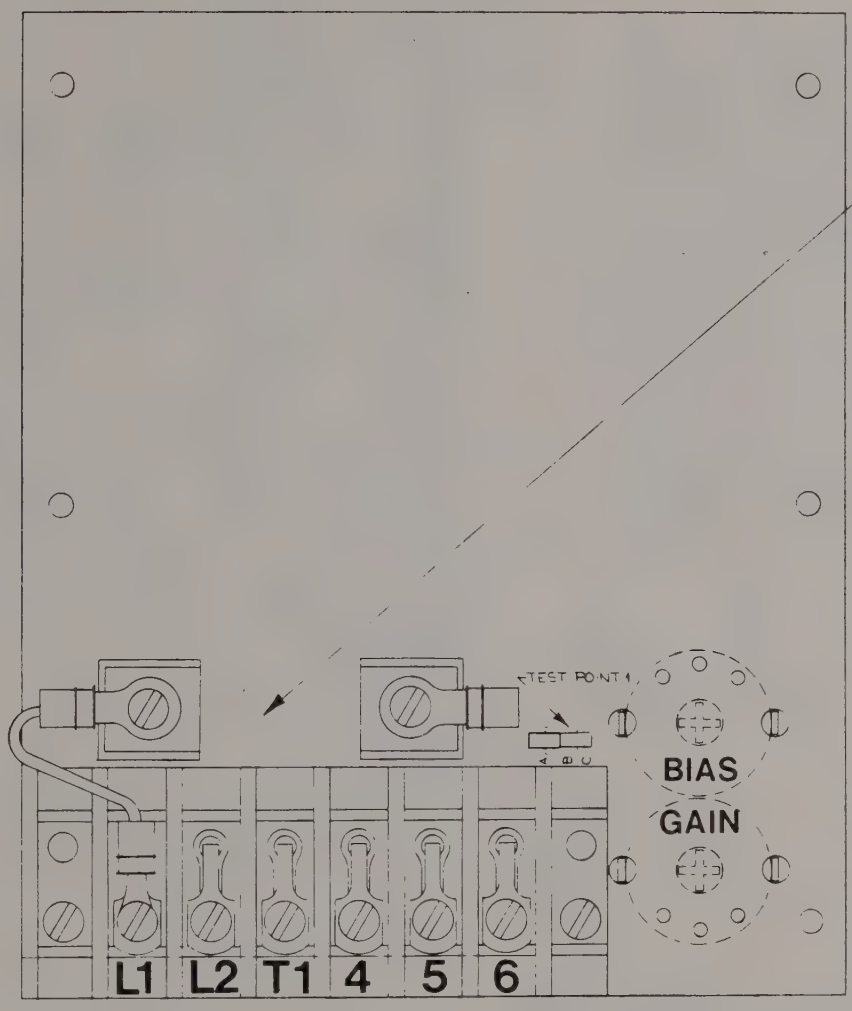
7.65 Check for conformity to the graph at various control inputs between full ON and full OFF. If the converters are used, the control-output relationship will be linear; i.e., 50% output will correspond to 50% control input, etc.

7.66 If unit does not conform, do not attempt to repair P.C. board. Return unit to factory.

CAUTION: DO NOT REPLACE SCR'S OR RECTIFIERS WITHOUT TORQUE AND REMOUNTING INSTRUCTIONS FROM FACTORY.

FIG. 1

TOP VIEW OF P/C BOARD



361903

REVISIONS

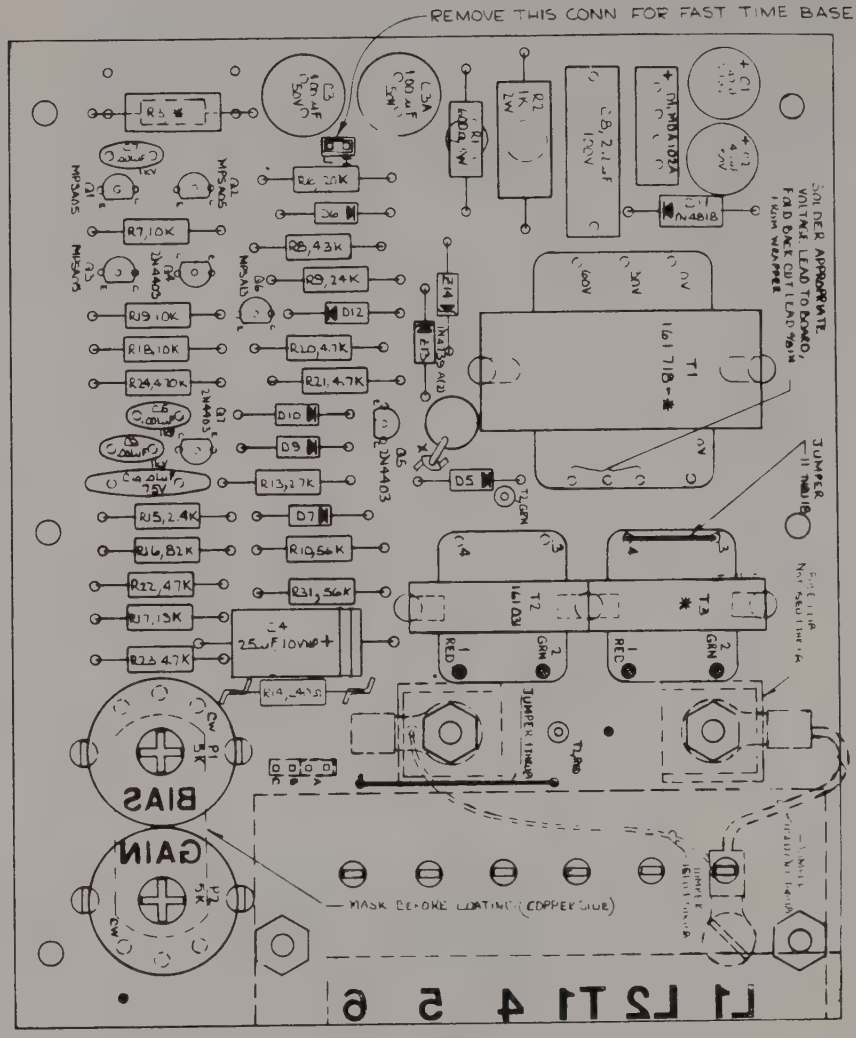
SCALE 1"=1"
DATE 2-2-80
DRAWN RDH
REVIEW
APPROVE

COLMAN Robicon Corporation
A BARBER COLMAN COMPANY

TITLE SCR POWER CONTROL BOARD
DWG NO 361903

FIG. 2

BOTTOM VIEW OF P/C BOARD


REMOVE THIS CONN FOR FAST TIME BASE
SOLDER APPROPRIATE VOLTAGE LEAD TO BOARD, FOLD BACK CUT LEAD WITH INSULATING WRAPPER
T1 161718-*
T2 161031
T3 *
JUMPER
BIAS
GAIN
MASK BEFORE COATING (COPPER SIDE)
L1 L2 T1 4 5 6

* COMPONENT CHART				
361310-	VOL.	T1	T3	R3
-1	120V	161718-1	161031-1	62Ω, 1W
-2	208V	-1		
-3	240V	-1		
-4	277V	-2		
-5	347V	-2		
-6	415V	-2		
-7	480V	-3		
-8	600V	-3		
-9				
-10				
-11	120V	161718-1	JUMPER	130Ω, 1W
-12	208V	-1		
-13	240V	-1		
-14	277V	-2		
-15	347V	-2		
-16	415V	-2		
-17	480V	-3		
-18	600V	-3		

361901

REVISIONS

SCALE	NONE
DATE	7-23-80
DRAWN	RDH
REVIEW	
CHECK	
APPROVE	RK

Robicon Corporation
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CUSTOMER

WORK ORDER

TITLE: BOTTOM VIEW POWER CONTROL BOARD

DWG NO. 361901

REV'S

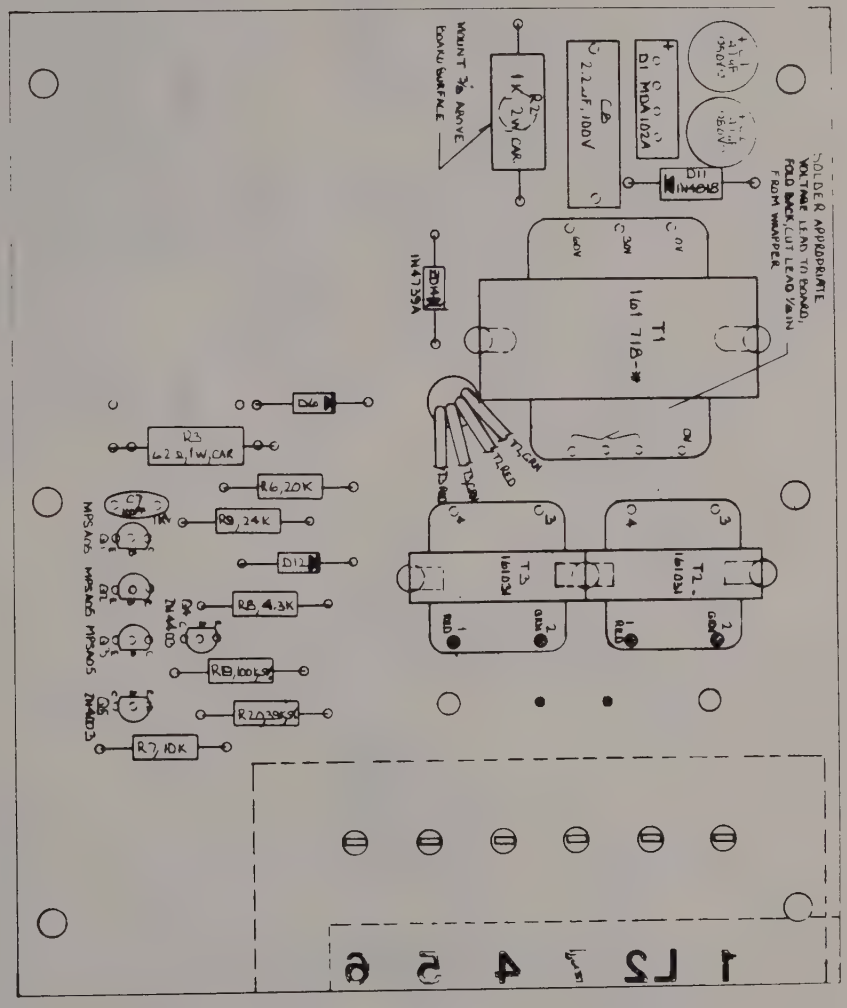
ORIGINATOR

SHT NO.

FIG. 3

BOTTOM VIEW OF P/C BOARD

* COMPONENT CHART			
361813-	VOLTAGE	T1	
-1	120V	161718-1	
-2	208V		-1
-3	240V		-1
-4	277V		-2
-5	347V		-2
-6	415V		-2
-7	480V		-3
-8	600V		-3
-9			
-10			
-11			
-12			
-13			
-14			
-15			
-16			
-17			



361902

REVISIONS

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BOTTOM VIEW POWER CONTROL SLAVE BOARD

361902

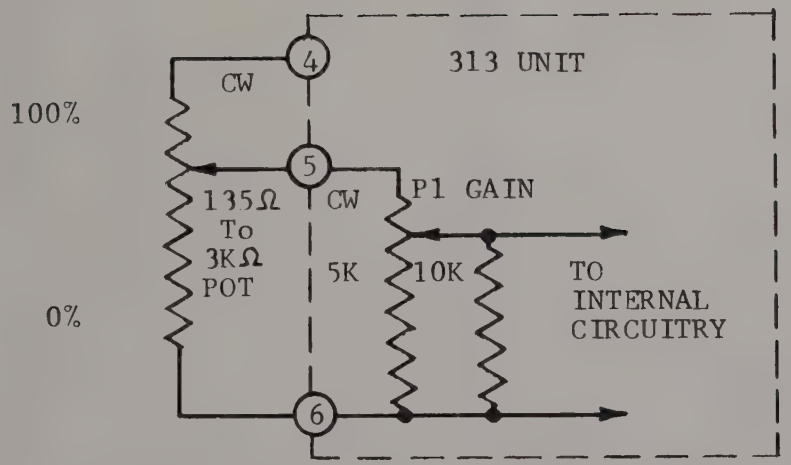


FIGURE 4. REMOTE CONTROL USING MANUAL POT.

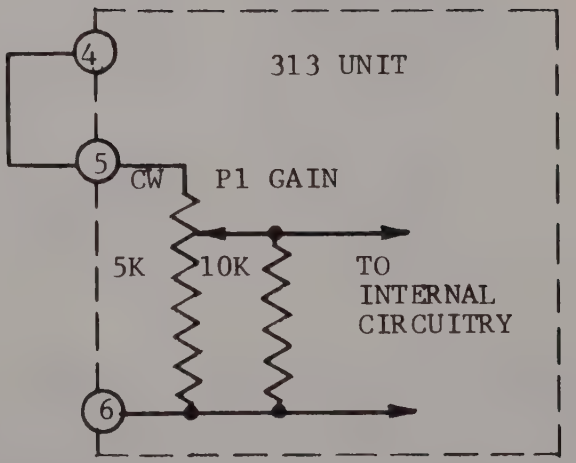


FIGURE 5. MANUAL CONTROL USING P1 GAIN POT. FULL OUTPUT WILL BE OBTAINED AT APPROXIMATELY 1/3 CW ROTATION (FROM FULL CCW POSITION).

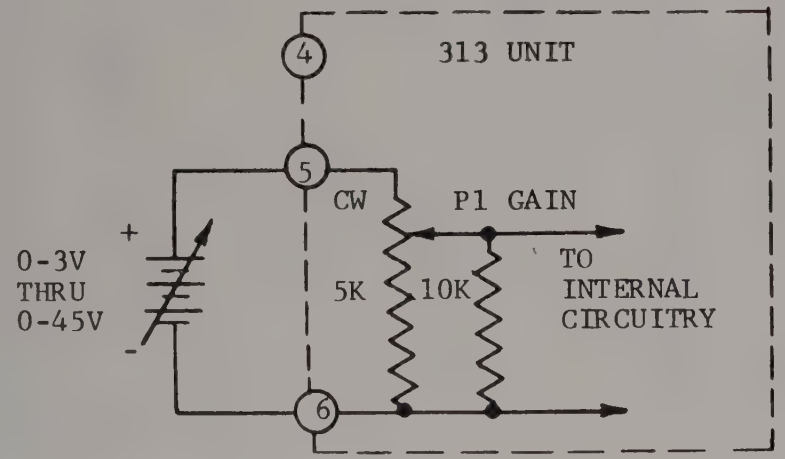


FIGURE 6. CONTROL USING DC VOLTAGE SOURCE. INPUT RESISTANCE VARIES BETWEEN 3K AND 5K +10% (DEPENDING UPON SETTING OF P1 GAIN POT.).

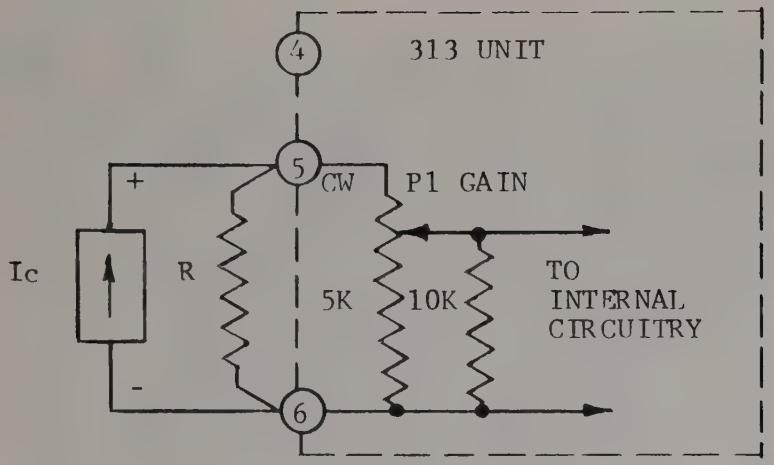


FIGURE 7. CONTROL USING DC MILLIAMPERE SOURCE. MINIMUM CONTROL CURRENT REQUIRED FOR FULL OUTPUT (MAXIMUM GAIN: P1 FULL CW) MUST SATISFY THE FOLLOWING RELATION:

$$\frac{R \times 3K}{R + 3K} I_c = 3 \text{ VOLTS},$$

WHERE R IS SELECTED TO MATCH THE LOADING REQUIREMENT OF THE INSTRUMENT (MILLIAMPERE SOURCE), MAXIMUM CONTROL CURRENT MUST NOT EXCEED POWER RATING OF RESISTOR R (1/2 W) OR GAIN POT P1 (2W).

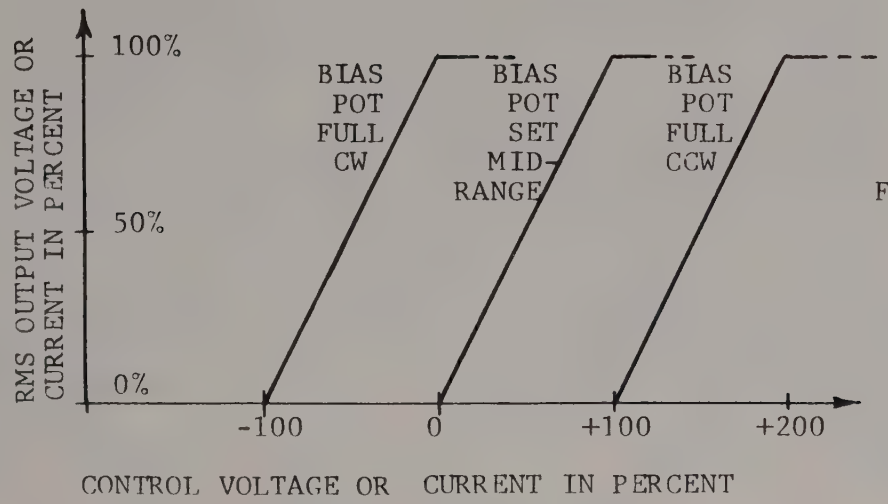
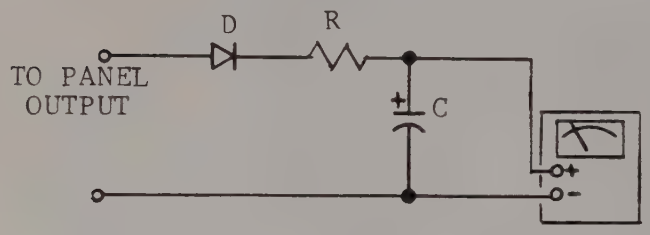


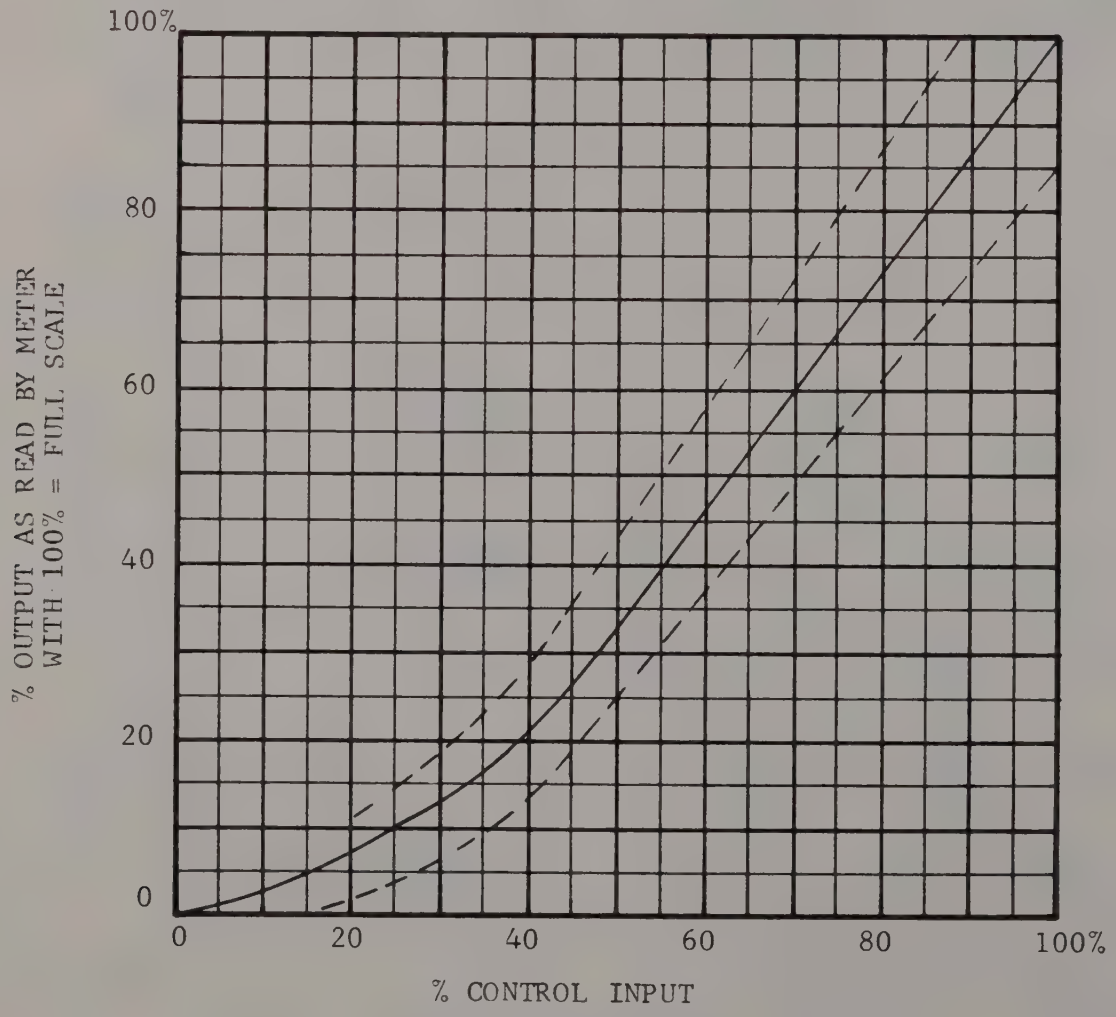
FIGURE 8. RMS OUTPUT VOLTAGE OR CURRENT VS. CONTROL VOLTAGE OR CURRENT FOR VARIOUS BIAS POT SETTINGS.

Figure 9

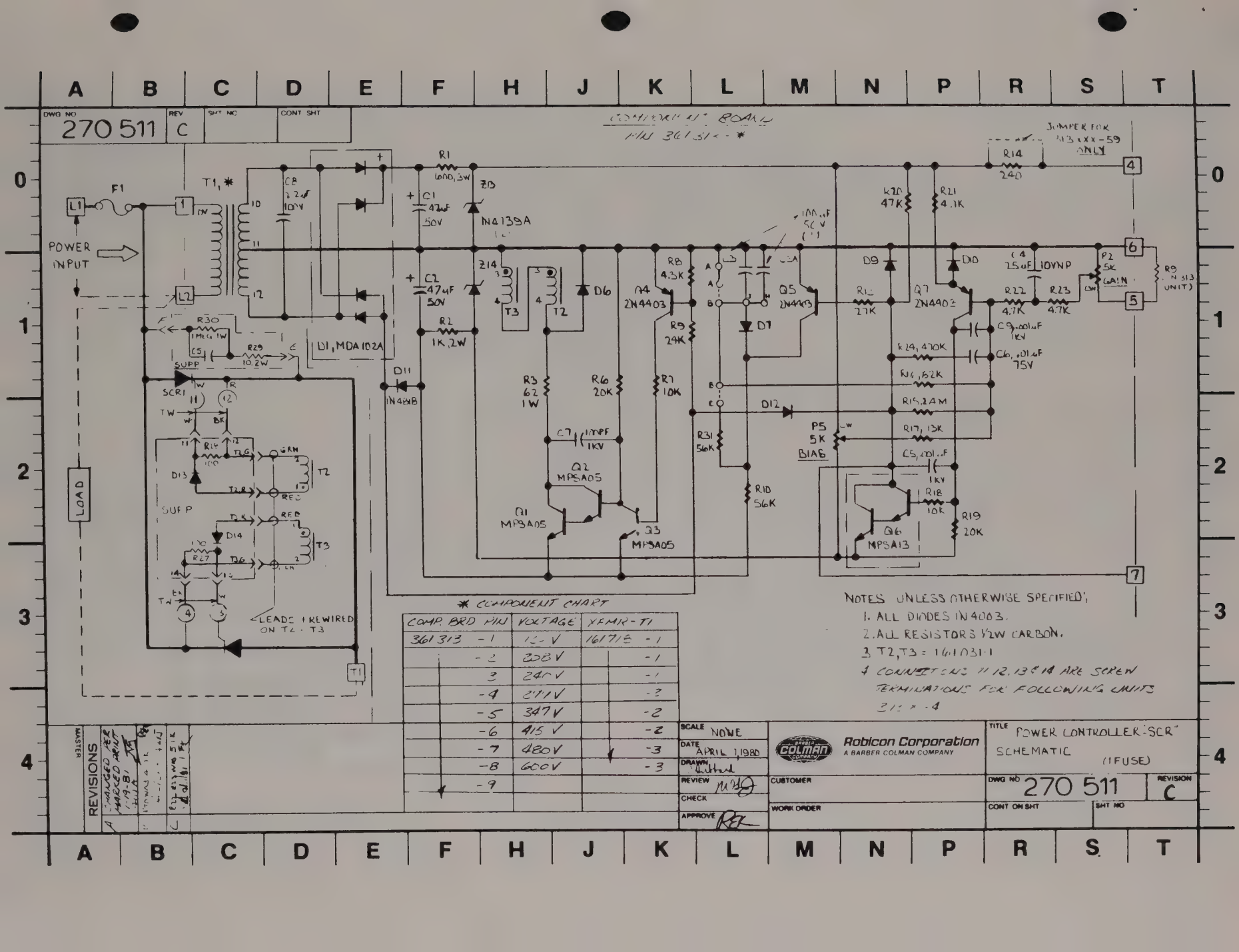
MEDIUM ACCURACY TEST CIRCUIT



VOLTAGE RATING	RESISTOR R (OHM)	CAPACITOR C (POLAR)	DIODE (OR EQUIV.)	SET METER RANGE TO
600V	5.1 MEG	3MFD/50V	1N4007, 1N5054	50V DC
480V	3.9 MEG	3MFD/50V	1N4006, 1N5053	50V DC
277V	2.2 MEG	3MFD/50V	1N4005, 1N4821	50V DC
240V	2.0 MEG	3MFD/50V	1N4004, 1N4820	50V DC
208V	1.8 MEG	3MFD/50V	1N4004, 1N4820	50V DC
120V	1.0 MEG	15MFD/10V	1N4004, 1N4819	10V DC



DASHED LINES INDICATE ACCEPTABLE ERROR LIMITS.



* COMPONENT CHART

COMP. BRD P/N	VOLTAGE	XFMR-T1
361 313 -1	120 V	161718 -1
-2	208 V	-1
-3	240 V	-1
-4	277 V	-3
-5	347 V	-2
-6	415 V	-2
-7	480 V	-3
-8	600 V	-3
-9		

NOTES UNLESS OTHERWISE SPECIFIED;

1. ALL DIODES IN4003.
2. ALL RESISTORS ½W CARBON.
3. T2, T3 = 161031-1
4. CONNECTIONS 11, 12, 13 & 14 ARE SCREW TERMINATIONS FOR FOLLOWING UNITS 313 XXX -4

REVISIONS

A	CHANGED PER MARCED ARNT 1-19-81		
B			
C			

SCALE	NONE
DATE	APRIL 1, 1980
DRAWN	
REVIEW	
CHECK	
APPROVE	

Robicon Corporation
A BARBER COLMAN COMPANY

CUSTOMER

WORK ORDER

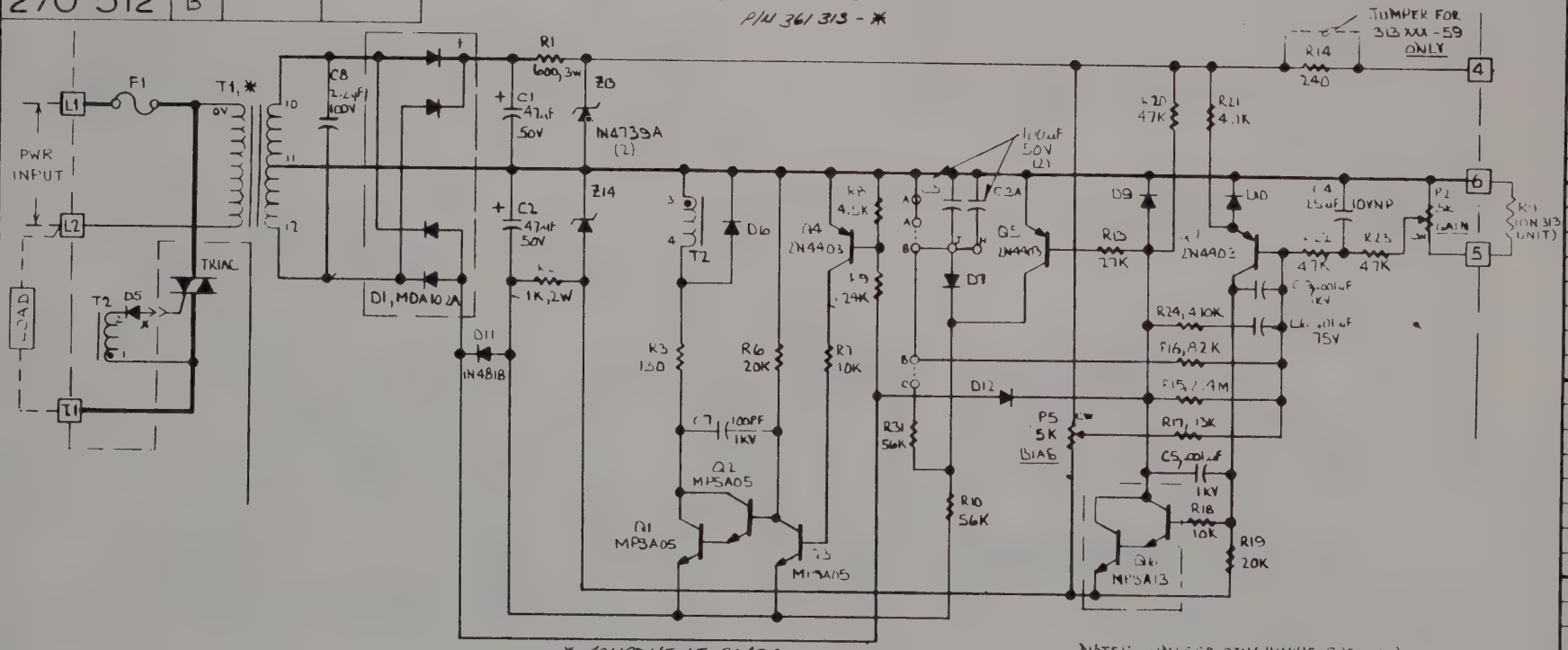
TITLE POWER CONTROLLER-SCR SCHEMATIC (1 FUSE)

DWG NO 270 511 REVISION C

CONT ON SHT SHT NO

DWG NO 270 512 | REV B | SHT NO | CONT SHT

COMPONENT BOARD
P/N 361 313 - *



NOTES UNLESS OTHERWISE SPECIFIED
1. ALL DIODES IN4003.
2. ALL RESISTORS ½W CARBON.
3. T2 = 161031-1

* COMPONENT BOARD

COMP. BRD. P/N	VOLTAGE	XFMR-T1
361 313 -11	120 V	161718 -1
-12	208 V	-1
-13	240 V	-1
-14	277 V	-2
-15	347 V	-2
-16	415 V	-2
-17	480 V	-3
-18	600 V	-3
-19		

REVISIONS			
A	CHANGED PER LETTER DATED 11-1-80 407A	JS	
B	R22, R23 WAS 51K	RK	4-24-81

SCALE NONE
DATE APRIL 1, 1980
DRAWN
REVIEW
CHECK
APPROVE RK

Robicon Corporation
A BARBER COLMAN COMPANY

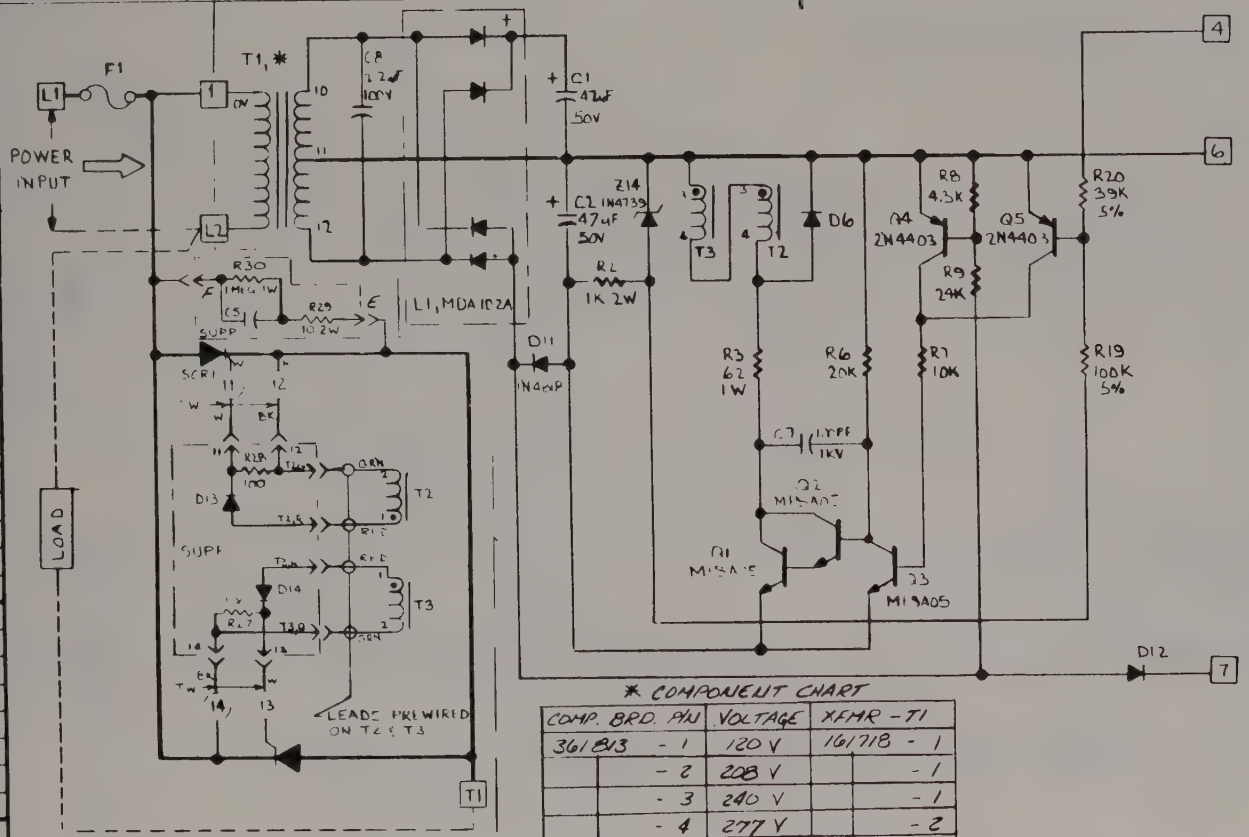
CUSTOMER
WORK ORDER

TITLE POWER CONTROLLER "TRIAC" SCHEMATIC - PN 361 313-11 thru 19

DWG NO 270 512 | REVISION B
CONT ON SHT | SHT NO

DWG NO 270 513 | REV A | SHT NO | CONT SHT

COMPONENT BOARD P/N 361 813 *



* COMPONENT CHART

COMP. BRD. P/N	VOLTAGE	XFMR - T1
361 813 - 1	120 V	161718 - 1
- 2	208 V	- 1
- 3	240 V	- 1
- 4	277 V	- 2
- 5	347 V	- 2
- 6	415 V	- 2
- 7	480 V	- 3
- 8	600 V	- 3
- 9		
- 10		

NOTES: UNLESS OTHERWISE SPECIFIED;
1. ALL DIODES IN4003.
2 ALL RESISTORS ½W CARBON
3. T2, T3 = 161031-1

MASTER

REVISIONS

A	CHANGED PER MARKED PRINT 11-3-81 JCA	JS

SCALE NONE
DATE APRIL 7, 1980
DRAWN
REVIEW
CHECK
APPROVE REK

Robicon Corporation
A BARBER COLMAN COMPANY

CUSTOMER
WORK ORDER

TITLE SCR POWER CONTROLLER "SLAVE" SCHEMATIC

DWG NO 270 513 | REVISION A

CONT ON SHT | SHT NO

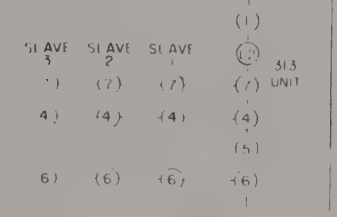
NOTES

1) ALL 313 UNITS ARE TRIAC SCR POWER CONTROLLERS WHICH PROVIDE SOLID STATE, ZERO VOLTAGE GATING, TIME PROPORTIONING CONTROL OF SINGLE PHASE AC POWER. SINGLE TRIACS ARE USED UP TO 25 AMPERES WHILE INVERSE PARALLEL CONNECTED SCR'S ARE USED ABOVE 25 AMPERES.

2) TIME PROPORTIONING IS OBTAINED BY GATING THE TRIAC SCR'S FOR CERTAIN NUMBER OF "ON" HALF CYCLES, AND BY NOT GATING THE TRIAC SCR FOR A NUMBER OF "OFF" HALF CYCLES OF THE AC SUPPLY. THE RATIO OF THE NUMBER OF "ON" HALF CYCLES TO THE TOTAL NUMBER OF "ON" PLUS "OFF" HALF CYCLES (DUTY CYCLE) IS PROPORTIONAL TO THE AVERAGE POWER DELIVERED TO THE RESISTIVE LOAD. EITHER THE RMS OR AVERAGE VALUE OF THE "ON" VOLTAGE OR CURRENT IS AN APPROXIMATELY LINEAR FUNCTION OF THE DC INPUT CONTROL SIGNAL, DEPENDING ON CONTROL GAIN. THESE UNITS CANNOT BE OPERATED INTO TRANSFORMER COUPLED LOADS OR HIGH INDUCTIVE LOADS. NOTE: 313 AT MOMENTARY OVERLOADS OF 300% CAN BE TOLERATED FOR 166 MILLISECONDS (10 AC CYCLES)

3) ALL UNITS ARE CSA APPROVED. REFER TO FILE CARD NO. 25175, GUIDE 184N90 CLASS 3211

4) ALL 313 UNITS 40 AMPERES AND ABOVE ARE CAPABLE OF DRIVING UP TO SEVEN SLAVE 313 UNITS GENERALLY USED FOR 3Φ 4 WIRE OPERATION. SEE FIG. BELOW



MASTER/SLAVE HOOKUP

ANY CONTROL SIGNAL IN NOTE 9 MAY BE USED WITH MASTER/SLAVE

SLAVE REQUIRES NO "PROCESS" SIGNAL

5) NOMINAL LINE VOLTAGE OF ALL LISTED 313'S ARE: 120, 208, 240, 277, 347, 380, 415, 480, 600VAC ±10% 50/60 Hz

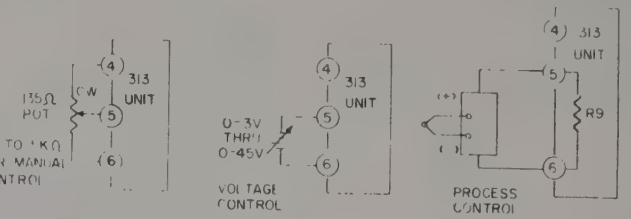
THE NAMEPLATE CURRENT RATING IS DESIGNED FOR AN AMBIENT AIR TEMPERATURE OF 50°C (122°F). THE 313 UNITS MAY BE USED UP TO 65°C (149°F) AMBIENT AIR IF THE NAMEPLATE CURRENT RATING IS REDUCED 3.33 PER DEGREE CENTIGRADE ABOVE 50°C. SEE TABLE 1 FOR CURRENT RANGES THAT ARE AVAILABLE. A.) UNITS ARE CONVECTION COOLED. NOT FAN COOLED. DO NOT RESTRICT THE AIR FLOW WHEN INSTALLING UNITS.

6) REFER TO TABLE 2 FOR AVAILABLE DC MILLIAMPERE CONTROL RANGES. ADD THE PART NUMBER SUFFIX TO THE PART NUMBER OBTAINED IN TABLE 1 BASED ON VOLTAGE AND AMPERES DESIRED

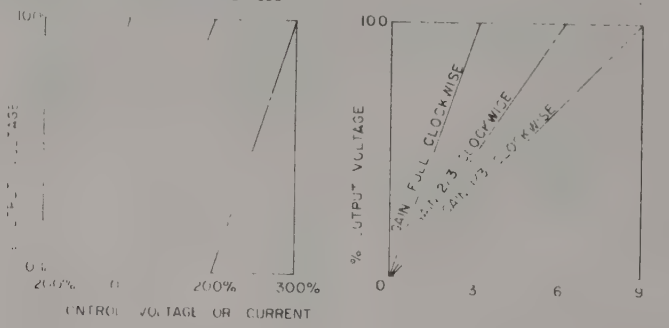
7) ALL UNITS ARE PROVIDED WITH A PRINTED CIRCUIT PLUG TO CHANGE OUTPUT SHAPING FOR RMS VOLTAGE OR CURRENT LINEAR WITH COMMAND OR POWER LINEAR WITH COMMAND SIGNAL

8) THESE UNITS ARE SHIPPED WITH A REPETITION RATE OF 50 PER MINUTE. A PLUG IS PROVIDED INTERNALLY TO MAKE ALL UNITS OPERATE AT 3 TIMES REPETITION RATE (FAST TIME BASE.)

9) COMMON CONTROL CONNECTIONS FOR ALL UNITS



10) BIAS AND GAIN CHARACTERISTICS



11) SEE INSTRUCTION MANUAL 900 800 FOR ADDITIONAL DETAILS IN SETTING BIAS, GAIN, TROUBLESHOOTING AIDS, SCHEMATICS AND PART LAYOUTS.

TITLE	TIME PROPORTION PWR CONT NOTES
DWG NO	313100
REVISION	0
SHT NO	1
CONT SHT	2
CUSTOMER	
WORK ORDER	
SCALE	NTS
DATE	6-4-80
DRAWN	KJB
REVIEW	
CHECK	
APPROVE	

Robicon Corporation
A GARDNER-DENVER COMPANY

REVISIONS

CONT SHT	SHT NO	DWG NO	REV
	1	313100	

TABLE 1

REPLACEMENT PARTS

P No.	V	A	OUTLINE FIG	SCHEM FIG	PWR TERM. L1, T1	PWR TERM L2	** TRIAC	W SCR SCR1-2	CH - SH FUSE F1 (& F2 WHEN USED)	ROBICON SUPPRESSOR SUPP	ROBICON COMP BRD C B
313 121	120	10	1	A	#16-14 SCREW	#16-14 SCREW	SC250D	——	A25X12	——	361 313 11
313 122		20	1	A			2N5445	——	A25X25	——	
313 123		25	1	A				——	A25X30	——	
313 124		40	2	B	#6-14 PRESSURE LUG		——	T510055004	A50P50	361 315-01 361 315-02	361 313-01
313 125		50	3	D	#2-8		——		A50P60	361 314-01	
313 126		77	4	D			——		A50P100		
313 127		110	5	C	250MCM 6		——	T510058004			
313 128		154	5	C			——	T610051304	A50P150		
313 129		180	6	D	250MCM-6		——	T630053004	A50P200		
313 130		220	6	D			——		A50P250		
313 131		310	7	D	600MCM-1		——		A50P350		
313 621	208	10	1	A	#16-14 SCREW	#16-14 SCREW	SC250D	——	A25X12	——	361 313 14
313 622		20	1	A			2N5445	——	A25X25	——	
313 623		25	1	A				——	A25X30	——	
313 624		40	2	B	#6-14 PRESSURE LUG		——	T510055004	A50P50	361 315-01 361 315-02	361 313-02
313 625		50	3	D	#2-8		——		A50P60	361 314-01	
313 626		77	4	D			——		A50P100		
313 627		110	5	C	250MCM 6		——	T510058004			
313 628		154	5	C			——	T610051304	A50P150		
313 629		180	6	D	250MCM-6		——	T630053004	A50P200		
313 630		220	6	D			——		A50P250		
313 631		310	7	D	600MCM-1		——		A50P350		
313 221	240	10	1	A	#16-14 SCREW	#16-14 SCREW	SC250D	——	A25X12	——	361 313-13
313 222		20	1	A			2N5445	——	A25X25	——	
313 223		25	1	A				——	A25X30	——	
313 224		40	2	B	#6-14 PRESSURE LUG		——	T510055004	A50P50	361 315-01 361 315-02	361 313 03
313 225		50	3	D	#2-8		——		A50P60	361 314-01	
313 226		77	4	D			——		A50P100		
313 227		110	5	C	250MCM 6		——	T510058004			
313 228		154	5	C			——	T610051304	A50P150		
313 229		180	6	D	250MCM-6		——	T630053004	A50P200		
313 230		220	6	D			——		A50P250		
313 231		310	7	D	600MCM-1		——		A50P350		
313 421	277	10	1	A	#16-14 SCREW	#16-14 SCREW	SC250E	——	KAC12	——	361 313-14
313 422		20	1	A			2N5446	——	KAC25	——	
313 423		25	1	A				——	KAC30	——	
313 424		40	2	B	#6-14 PRESSURE LUG		——	T510065004	A50P50	361 315-01 361 315-02	361 313-04
313 425		50	3	D	#2-8		——		A50P60	361 314-01	
313 426		77	4	D			——		A50P100		
313 427		110	5	C	250MCM 6		——	T510068004			
313 428		154	5	C			——	T610061304	A50P150		
313 429		180	6	D	250MCM-6		——	T630063004	A50P200		
313 430		220	6	D			——		A50P250		
313 431		310	7	D	600MCM-1		——	T620103004	A50P350		
313 721	347	10	1	A	#16-14 SCREW	#16-14 SCREW	T6420N	——	KAC12	——	361 313-15
313 722		20	1	A				——	KAC25	——	
313 723		25	1	A				——	KAC30	——	
313 724		40	2	B	#6-14 PRESSURE LUG		——	T500104004	A50P50	361 315-01 361 315-03	361 313-05
313 725		50	3	D	#2-8		——		A50P60	361 314-02	
313 726		77	4	D			——		A50P100		
313 727		110	5	C	250MCM 6		——	T500108004			
313 728		154	5	C			——	T600101304	A50P150		
313 729		180	6	D	250MCM-6		——	T620103004	A50P200		
313 730		220	6	D			——		A50P250		
313 731		310	7	D	600MCM-1		——		A50P350		

REVISIONS

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COLMAN Robicon Corporation
A BARBER-COLMAN COMPANY

CUSTOMER

TITLE TIME PROPORTION PWR CONT TABLE

DWG NO 313 100 REVISION E

CONT ON SHT 3 SHT NO 2

TABLE 1 (con't)

REPLACEMENT PARTS

P/N	V	A	OUTLINE FIG	SCHEM FIG	PWR TERM L1, T1	PWR TERM. L2	** TRIAC	W SCR SCR1-2	CH -SH. FUSE F1 (& F2 WHEN USED)	RORICON SUPPRESSOR SUPP	ROBICON COMP BRD C.B
313 821	380 415	10	1	A	#16-14 SCREW	#16-14 SCREW	T6420N	——	KAC12	—— ——	361 313 16
313 822		20	1	A				——	KAC25	——	
313 823		25	1	A				——	KAC30	——	
313 824		40	2	B	#6-14 PRESSURE LUG		——	T500104004	A50P50	361 315-01 361 315-03	361 313-06
313 825		50	3	D	#2-8		——		A50P60	361 314-02	
313 826		77	4	D			——		A50P100		
313 827		110	5	C	250MCM 6		——	T500108004			
313 828		154	5	C			——	T600101304	A50P150		
313 829		180	6	D	250MCM-6		——	T620103004	A50P200		
313 830		220	6	D			——		A50P250		
313 831		310	7	D	600MCM-1		——		A50P350		
313 321	480	10	1	A	#16-14 SCREW	#16-14 SCREW	T6420N	——	KAC12	——	361 313-17
313 322		20	1	A				——	KAC25	——	
313 323		25	1	A				——	KAC30	——	
313 324		40	2	B	#6-14 PRESSURE LUG		——	T500104004	A50P50	361 315-01 361 315-03	361 313-07
313 325		50	3	D	#2-8		——		A50P60	361 314-02	
313 326		77	4	D			——		A50P100		
313 327		110	5	C	250MCM-6		——	T500108004			
313 328		154	5	C			——	T600101304	A50P150		
313 329		180	6	D	250MCM-6		——	T620103004	A50P200		
313 330		220	6	D			——		A50P250		
313 331		310	7	D	600MCM-1		——		A50P350		
313 521	600	10	1	A	#16-14 SCREW	#16-14 SCREW	BTX941000	——	KAC12	——	361 313-18
313 522		20	1	A				——	KAC25	——	
313 523		25	NOT AVAILABLE								
313 524		40	2	B	#6-14 PRESSURE LUG		——	T500124004	A70P50	361 315-01 361 315-03	361 313-08
313 525		50	3	D	#2-8		——		A70P60	361 314-02	
313 526		77	4	D			——		A70P100		
313 527		110	5	C	250MCM 6		——	T500128004			
313 528		154	5	C			——	T600121304	A70P150		
313 529		180	6	D	250MCM-6		——	T620123004	A70P200		
313 530		220	6	D			——		A70P250		
313 531		310	7	D	600MCM-1		——		A70P350		

**

TRIAC-MFGR

SC250D	GE
SC250E	
2N5445	RCA
2N5446	
T6420N	MOTOROLA
BTX941000	AMPEREX

TABLE 2

P/N SUFFIX	DC MILLIAMPERE CONTROL			
	NOMINAL INPUT RESISTANCE (OHMS)	NOMINAL RANGE (MA)	INPUT MATCHING RESISTOR(R9) ACROSS TERMINALS 5-6 (OHMS) (1/2W UNLESS OTHERWISE NOTED)	MINIMUM CURRENT RANGE (MA)
-40	3.33K-5K		NO RESISTOR	0-1.0
-41	230	4-20	240	0-15
-42	340	4-20	360	0-10
-43	430	4-20	470	0-8
-44	600	10-50	680 2W	0-6
-45	770	4-20	910	0-4.7
-46	970	0-5	1200	0-3.8
-47	1150	4-20	1500	0-3.3
-48	1430	0-5	2000	0-2.7
-49	1430	2-12	2000	0-2.7
-50	2000	0-5	3300	0-2.0
-51	2800	1-5	6800	0-1.5
-52	4000	-5	20K	0-1.2
-53	4000	-7	20K	0-1.2
-54	5000	1-5	NO RESISTOR	0-1.2
-55	10K	1-5	NO RESISTOR	0-1.0
-56	1430	1-5	2000	0-2.7
-57	970	12-20	1200	0-3.8
-58	430	0-20	470	0-8
-59	3.33K-5K	6-9VDC	NO RESISTOR	0-1.0

NOTE:
-0 THRU -39 WILL NEVER EXIST FOR THE P/N LISTED IN TABLE 1.

CONT SHT 4 | SHT NO 3 | DWG NO 313100 | REV B

MASTER REVISIONS

SCALE NTS | DATE 6-4-80 | DRAWN KJB | REVIEW MGJ | CHECK | APPROVE RJK

Robicon Corporation
A BARBER-COLMAN COMPANY

CUSTOMER | WORK ORDER

TITLE: TIME PROPORTION PWR CONT TABLE 1(con't), TABLE 2

DWG NO 313100 | REVISION B | CONT ON SHT 4 | SHT NO 3

FIG A

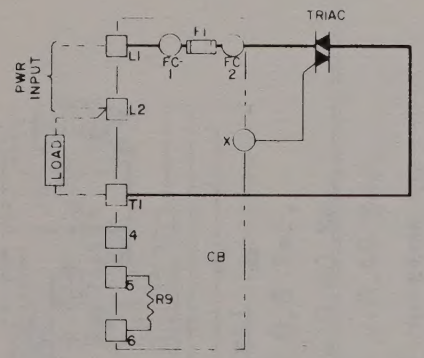


FIG B

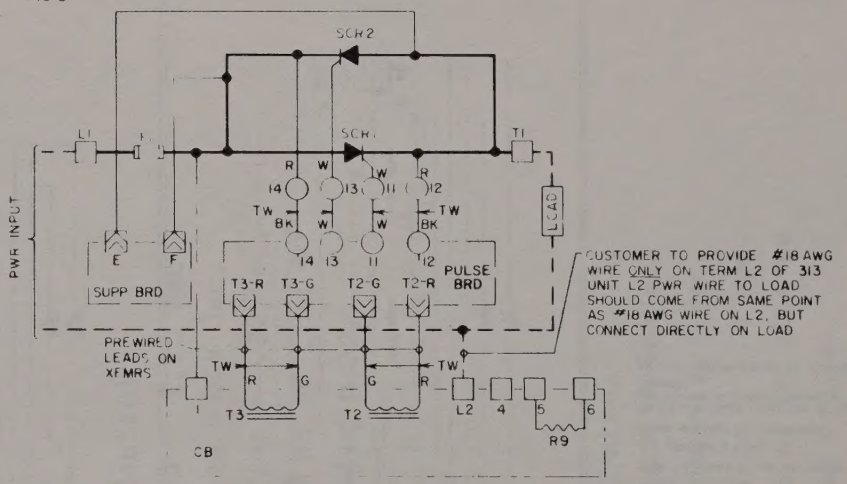


FIG C

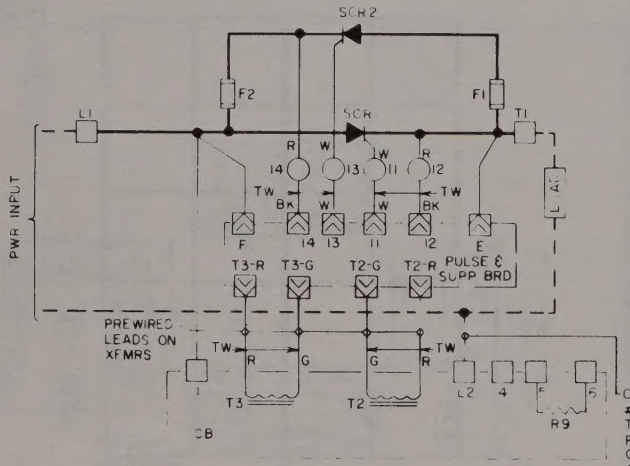
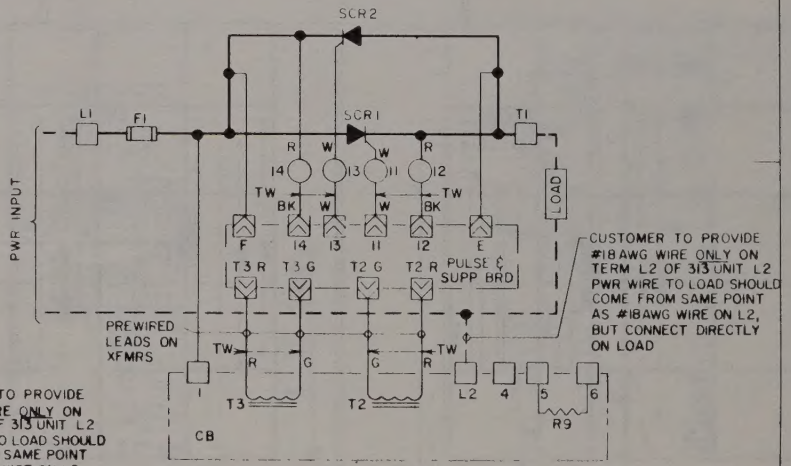


FIG D



TITLE: TIME PROPORTION PWR CONT SCHEMATICS

Robicon Corporation, A BALDWIN-COLMAN COMPANY

DWG NO 313 100 | REVISION B | SHT NO 4 | CONT ON SHT 5

CUSTOMER - | WORK ORDER

SCALE NTS | DATE 6-4-80 | DRAWN KJB | REVIEW MGJ | CHECK | APPROVE

REVISIONS

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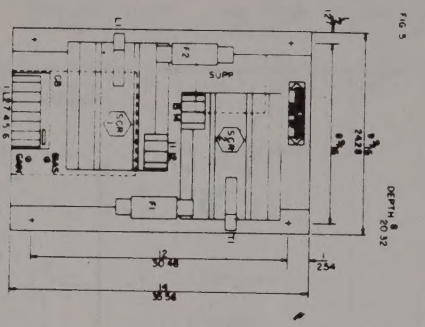
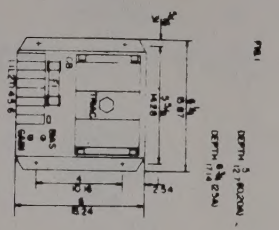
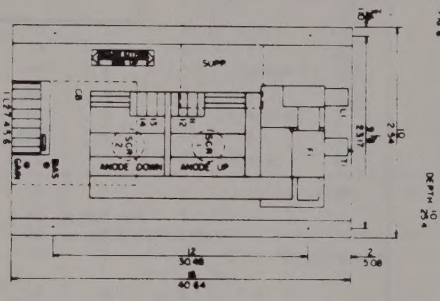
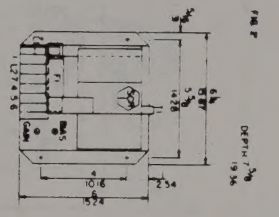
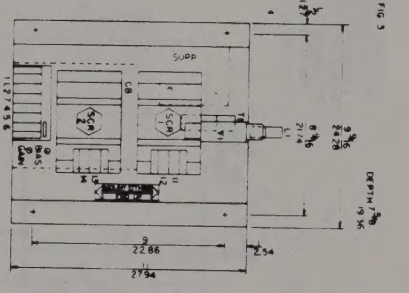
CONT SHT 5 | SHT NO 4 | DWG NO 313 100 | REV B

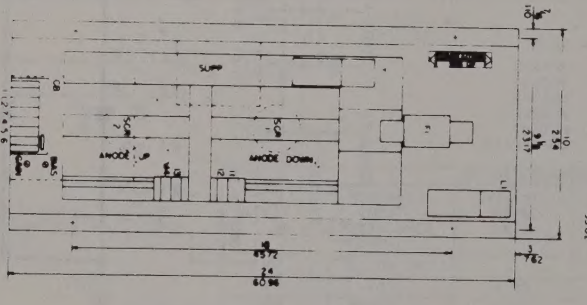


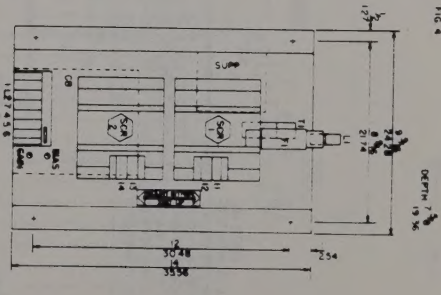








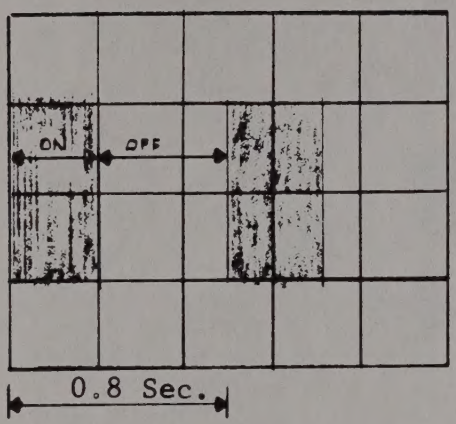




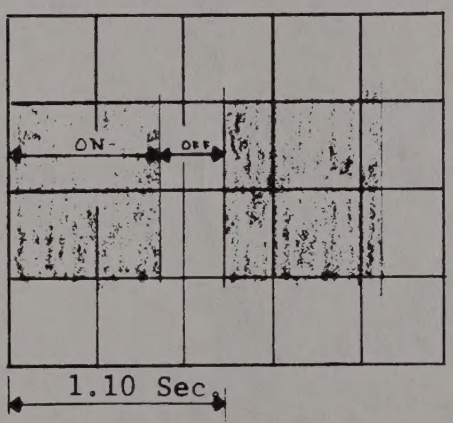
NOTES
FIG 1-7 ALL HAVE 9/32 DIA MTG HOLES
TOP DIMENSION IS INCHES
LOWER DIMENSION IS CENTIMETERS
FIG 1,2 HAVE "MOUNT EITHER END UP" DECAL ON LEFT SIDE OF CHASSIS (LOOKING AT OUTLINE)
FIG 1-7 ALL HAVE PB ACROSS TOP OF TERMINAL 5/6

| | | |

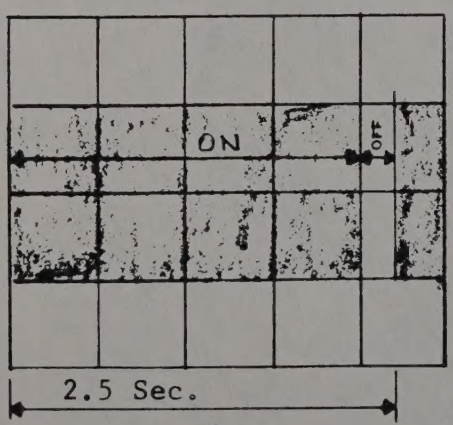
TYPICAL OSCILLOSCOPE TRACES
SERIES 313 TIME
PROPORTIONING CONTROLLERS



70% Control
Period = 0.8 Sec.
On Time = 0.40 Sec.
Off Time = 0.40 Sec.
Ratio of on time to
Period = 0.50



84% Control
Period = 1.10 Sec.
On Time = 0.8 Sec.
Off Time = .32 Sec.
Ratio of on time to
Period = 0.72



95% Control
Period = 2.50 Sec.
On Time = 2.3 Sec.
Off Time = 0.3 Sec.
Ratio of on time to
Period = 0.90

MP MASTER
MA32099